ATTACHMENT IV

INTAKE AND RISK CALCULATIONS

INTAKE AND RISK CALCULATIONS FOR DERMAL CONTACT
(AREA B; SOILS: 0 - 4 in. and 0.8 - 1.5 ft.)
INDUSTRIAL WORKER POPULATION
CURRENT SCENARIO

CDI (mg/kg-day) = (CS x CF x SA x AF x ABS x EF x ED) / (BW x AT)

RMI SODIUM PLANT
ASHTABULA, OHIO

Constituent	CS (mg/kg)	CF (kg/mg)	SA (cm^2/day)	AF (mg/cm^2)	ABS (unitless)	EF (days/yr)	ED (yr)	BW (kg)	NC AT (days)	C AT (days)	C Chronic Daily Intake (Administered) (mg/kg-day)	NC Chronic Daily Intake (Administered) (mg/kg-day)	Oral Slope Factor (SF) 1/(mg/kg-day)	Oral Reference Dose (RfD) (mg/kg-day)	Dermal Chemical-Specific Carcinogenic Risk	Dermal Chemical-Specific Noncarcinogenic Hazard Quotient	% Carcinogenic Risk	% Noncarcino-genic Risk
Arsenic	23.6	1.0E-06	5,800	1.0	0.01	250	25	70	9,125	25,550	4.8E-06	1.3E-05	1.8	0.0003	8.6E-06	4.3E-02	1.0E+02	9.6E+00
Cadmium	731	1.0E-06	5,800	1.0	0.01	250	25	70	9,125	25,550	1.5E-04	4.1E-04	-- [a]	0.001	--	4.1E-01	--	9.1E+01
Lead	1,140	1.0E-06	5,800	1.0	0.01	250	25	70	9,125	25,550	2.3E-04	6.5E-04	--	--	--	--	--	--
															TOTAL PATHWAY RISK:	8.6E-06	HAZARD INDEX:	4.5E-01

[a] Dashes (--) indicate that the slope factor (SF) and/or reference dose (RfD) were not available in the latest IRIS database (August 1994) or HEAST as of March 1994. Therefore, no risk were quantified.

INTAKE AND RISK CALCULATIONS FOR INCIDENTAL INGESTION
(AREA B; SOILS: 0 - 4 in. and 0.8 - 1.5 ft.)
INDUSTRIAL WORKER POPULATION
CURRENT SCENARIO

CDI (mg/kg-day) = (CS x CF x IR x FI x EF x ED) / (BW x AT)

RMI SODIUM PLANT
ASHTABULA, OHIO

Constituent	CS (mg/kg)	CF (kg/mg)	IR (mg/day)	FI (unitless)	EF (days/yr)	ED (yr)	BW (kg)	NC AT (days)	C AT (days)	C Chronic Daily Intake (mg/kg-day)	NC Chronic Daily Intake (mg/kg-day)	Oral Slope Factor (SF) 1/(mg/kg-day)	Oral Reference Dose (RfD) (mg/kg-day)	Oral Chemical-Specific Carcinogenic Risk	Oral Chemical-Specific Noncarcinogenic Hazard Quotient	% Carcinogenic Risk	% Noncarcino-genic Risk
Arsenic	23.6	1.0E-06	50	1.0	250	25	70	9,125	25,550	4.1E-06	1.2E-05	1.8	0.0003	7.4E-06	4.0E-02	1.0E+02	1.0E+01
Cadmium	731	1.0E-06	50	1.0	250	25	70	9,125	25,550	1.3E-04	3.6E-04	-- [a]	0.001	--	3.6E-01	--	9.0E+01
Lead	1,140	1.0E-06	50	1.0	250	25	70	9,125	25,550	2.0E-04	5.6E-04	--	--	--	--	--	--
														TOTAL PATHWAY RISK:	7.4E-06	HAZARD INDEX:	4.0E-01		

[a] Dashes (--) indicate that the slope factor (SF) and/or reference dose (RfD) were not available in the latest IRIS database (August 1994) or HEAST as of March 1994. Therefore, no risk were quantified.

INTAKE AND RISK CALCULATIONS FOR INHALATION OF PARTICULATES
(AREA B; SOILS: 0 - 4 in. and 0.8 - 1.5 ft.)
INDUSTRIAL WORKER POPULATION
CURRENT SCENARIO

CDI (mg/kg-day) = (CA x IR x ET x EF x ED) / (BW x AT)

RMI SODIUM PLANT
ASHTABULA, OHIO

Constituent	CA (mg/m^3)	IR (m^3/hr)	ET (hr/day)	EF (days/yr)	ED (yr)	BW (kg)	NC AT (days)	C AT (days)	C Chronic Daily Intake (mg/kg-day)	NC Chronic Daily Intake (mg/kg-day)	Inhalation Slope Factor (SF) 1/(mg/kg-day)	Inhalation Reference Dose (RfD) (mg/kg-day)	Inhalation Chemical-Specific Carcinogenic Risk	Inhalation Chemical-Specific Noncarcinogenic Hazard Quotient	% Carcinogenic Risk	% Noncarcino-genic Risk
Arsenic	2.7E-09	0.83	8	250	25	70	9,125	25,550	6.3E-11	1.8E-10	50	-- [a]	3.2E-09	--	2.1E+01	--
Cadmium	8.2E-08	0.83	8	250	25	70	9,125	25,550	1.9E-09	5.3E-09	6.3	--	1.2E-08	--	8.0E+01	--
Lead	1.3E-07	0.83	8	250	25	70	9,125	25,550	3.0E-09	8.4E-09	--	--	--	--	--	--
												TOTAL PATHWAY RISK :	1.5E-08	HAZARD INDEX :	--	

[a] Dashes (--) indicate that the slope factor (SF) and/or reference dose (RfD) were not available in the latest IRIS database (August 1994) or HEAST as of March 1994. Therefore, no risk were quantified.

INTAKE AND RISK CALCULATIONS FOR INCIDENTAL INGESTION
(AREA C; SOILS: 0 - 4 in. and 1.4 - 1.8 ft.)
INDUSTRIAL WORKER POPULATION
CURRENT SCENARIO

CDI (mg/kg-day) = (CS x CF x IR x FI x EF x ED) / (BW x AT)

RMI SODIUM PLANT
ASHTABULA, OHIO

Constituent	CS (mg/kg)	CF (kg/mg)	IR (mg/day)	FI (unitless)	EF (days/yr)	ED (yr)	BW (kg)	NC AT (days)	C AT (days)	C Chronic Daily Intake (mg/kg-day)	NC Chronic Daily Intake (mg/kg-day)	Oral Slope Factor (SF) 1/(mg/kg-day)	Oral Reference Dose (RfD) (mg/kg-day)	Oral Chemical-Specific Carcinogenic Risk	Oral Chemical-Specific Noncarcinogenic Hazard Quotient	% Carcinogenic Risk	% Noncarcino-genic Risk
Arsenic	23.4	1.0E-06	50	1.0	250	25	70	9,125	25,550	4.1E-06	1.1E-05	1.8	0.0003	7.4E-06	3.7E-02	1.0E+02	1.0E+02
Lead	209	1.0E-06	50	1.0	250	25	70	9,125	25,550	3.7E-05	1.0E-04	-- [a]	--	--	--	--	--
													TOTAL PATHWAY RISK :	7.4E-06	HAZARD INDEX :	3.7E-02		

[a] Dashes (--) indicate that the slope factor (SF) and/or reference dose (RfD) were not available in the latest IRIS database (August 1994) or HEAST as of March 1994. Therefore, no risk were quantified.

INTAKE AND RISK CALCULATIONS FOR INHALATION OF PARTICULATES
(AREA C; SOILS: 0 - 4 in. and 1.4 - 1.8 ft.)
INDUSTRIAL WORKER POPULATION
CURRENT SCENARIO

CDI (mg/kg-day) = (CA x IR x ET x EF x ED) / (BW x AT)

RMI SODIUM PLANT
ASHTABULA, OHIO

Constituent	CA (mg/m^3)	IR (m^3/hr)	ET (hr/day)	EF (days/yr)	ED (yr)	BW (kg)	NC AT (days)	C AT (days)	C Chronic Daily Intake (mg/kg-day)	NC Chronic Daily Intake (mg/kg-day)	Inhalation Slope Factor (SF) 1/(mg/kg-day)	Inhalation Reference Dose (RfD) (mg/kg-day)	Inhalation Chemical-Specific Carcinogenic Risk	Inhalation Chemical-Specific Noncarcinogenic Hazard Quotient	% Carcinogenic Risk	% Noncarcino-genic Risk
Arsenic	3.8E-09	0.83	8	250	25	70	9,125	25,550	8.8E-11	2.5E-10	50	-- [a]	4.4E-09	--	1.0E+02	--
Lead	3.4E-08	0.83	8	250	25	70	9,125	25,550	7.9E-10	2.2E-09	--	--	--	--	--	--
												TOTAL PATHWAY RISK:	4.4E-09	HAZARD INDEX:	--	

[a] Dashes (--) indicate that the slope factor (SF) and/or reference dose (RfD) were not available in the latest IRIS database (August 1994) or HEAST as of March 1994. Therefore, no risk were quantified.

INTAKE AND RISK CALCULATIONS FOR DERMAL CONTACT
(AREAS B & C; SOILS: 0 - 4 in. and 0.8 - 1.8 ft.)
INDUSTRIAL WORKER POPULATION
CURRENT SCENARIO

CDI (mg/kg-day) = (CS x CF x SA x AF x ABS x EF x ED) / (BW x AT)

RMI SODIUM PLANT
ASHTABULA, OHIO

Constituent	CS (mg/kg)	CF (kg/mg)	SA (cm^2/day)	AF (mg/cm^2)	ABS (unitless)	EF (days/yr)	ED (yr)	BW (kg)	NC AT (days)	C AT (days)	C Chronic Daily Intake (Administered) (mg/kg-day)	NC Chronic Daily Intake (Administered) (mg/kg-day)	Oral Slope Factor (SF) 1/(mg/kg-day)	Oral Reference Dose (RfD) (mg/kg-day)	Dermal Chemical-Specific Carcinogenic Risk	Dermal Chemical-Specific Noncarcinogenic Hazard Quotient	% Carcinogenic Risk	% Noncarcino-genic Risk
Arsenic	23.2	1.0E-06	5,800	1.0	0.01	250	25	70	9,125	25,550	4.7E-06	1.3E-05	1.8	0.0003	8.5E-06	4.3E-02	1.0E+02	9.6E+00
Cadmium	731	1.0E-06	5,800	1.0	0.01	250	25	70	9,125	25,550	1.5E-04	4.1E-04	-- [a]	0.001	--	4.1E-01	--	9.1E+01
Lead	1,140	1.0E-06	5,800	1.0	0.01	250	25	70	9,125	25,550	2.3E-04	6.5E-04	--	--	--	--	--	--
															TOTAL PATHWAY RISK:	8.5E-06	HAZARD INDEX:	4.5E-01		

[a] Dashes (--) indicate that the slope factor (SF) and/or reference dose (RfD) were not available in the latest IRIS database (August 1994) or HEAST as of March 1994. Therefore, no risk were quantified.

INTAKE AND RISK CALCULATIONS FOR INCIDENTAL INGESTION
(AREAS B & C; SOILS: 0 - 4 in. and 0.8 - 1.8 ft.)
INDUSTRIAL WORKER POPULATION
CURRENT SCENARIO

CDI (mg/kg-day) = (CS x CF x IR x FI x EF x ED) / (BW x AT)

RMI SODIUM PLANT
ASHTABULA, OHIO

Constituent	CS (mg/kg)	CF (kg/mg)	IR (mg/day)	FI (unitless)	EF (days/yr)	ED (yr)	BW (kg)	NC AT (days)	C AT (days)	C Chronic Daily Intake (mg/kg-day)	NC Chronic Daily Intake (mg/kg-day)	Oral Slope Factor (SF) 1/(mg/kg-day)	Oral Reference Dose (RfD) (mg/kg-day)	Oral Chemical-Specific Carcinogenic Risk	Oral Chemical-Specific Noncarcinogenic Hazard Quotient	% Carcinogenic Risk	% Noncarcino-genic Risk
Arsenic	23.2	1.0E-06	50	1.0	250	25	70	9,125	25,550	4.1E-06	1.1E-05	1.8	0.0003	7.4E-06	3.7E-02	1.0E+02	9.3E+00
Cadmium	731	1.0E-06	50	1.0	250	25	70	9,125	25,550	1.3E-04	3.6E-04	-- [a]	0.001	--	3.6E-01	--	9.0E+01
Lead	1,140	1.0E-06	50	1.0	250	25	70	9,125	25,550	2.0E-04	5.6E-04	--	--	--	--	--	--
														TOTAL PATHWAY RISK:	7.4E-06	HAZARD INDEX:	4.0E-01		

[a] Dashes (--) indicate that the slope factor (SF) and/or reference dose (RfD) were not available in the latest IRIS database (August 1994) or HEAST as of March 1994. Therefore, no risk were quantified.

INTAKE AND RISK CALCULATIONS FOR INHALATION OF PARTICULATES
(AREAS B & C; SOILS: 0 - 4 in. and 0.8 - 1.8 ft.)
INDUSTRIAL WORKER POPULATION
CURRENT SCENARIO

CDI (mg/kg-day) = (CA x IR x ET x EF x ED) / (BW x AT)

RMI SODIUM PLANT
ASHTABULA, OHIO

Constituent	CA (mg/m^3)	IR (m^3/hr)	ET (hr/day)	EF (days/yr)	ED (yr)	BW (kg)	NC AT (days)	C AT (days)	C Chronic Daily Intake (mg/kg-day)	NC Chronic Daily Intake (mg/kg-day)	Inhalation Slope Factor (SF) 1/(mg/kg-day)	Inhalation Reference Dose (RfD) (mg/kg-day)	Inhalation Chemical-Specific Carcinogenic Risk	Inhalation Chemical-Specific Noncarcinogenic Hazard Quotient	% Carcinogenic Risk	% Noncarcino-genic Risk
Arsenic	4.6E-09	0.83	8	250	25	70	9,125	25,550	1.1E-10	3.0E-10	50	-- [a]	5.5E-09	--	2.1E+01	--
Cadmium	1.4E-07	0.83	8	250	25	70	9,125	25,550	3.2E-09	9.1E-09	6.3	--	2.0E-08	--	7.7E+01	--
Lead	2.3E-07	0.83	8	250	25	70	9,125	25,550	5.3E-09	1.5E-08	--	--	--	--	--	--
												TOTAL PATHWAY RISK :	2.6E-08	HAZARD INDEX :	--	

[a] Dashes (--) indicate that the slope factor (SF) and/or reference dose (RfD) were not available in the latest IRIS database (August 1994) or HEAST as of March 1994. Therefore, no risk were quantified.

INTAKE AND RISK CALCULATIONS FOR DERMAL CONTACT
(AREA F; SOILS: 0 - 4 in. and 0.5 - 1.3 ft.)
INDUSTRIAL WORKER POPULATION
CURRENT SCENARIO

CDI (mg/kg-day) = (CS x CF x SA x AF x ABS x EF x ED) / (BW x AT)

RMI SODIUM PLANT
ASHTABULA, OHIO

Constituent	CS (mg/kg)	CF (kg/mg)	SA (cm^2/day)	AF (mg/cm^2)	ABS (unitless)	EF (days/yr)	ED (yr)	BW (kg)	NC AT (days)	C AT (days)	C Chronic Daily Intake (Administered) (mg/kg-day)	NC Chronic Daily Intake (Administered) (mg/kg-day)	Oral Slope Factor (SF) 1/(mg/kg-day)	Oral Reference Dose (RfD) (mg/kg-day)	Dermal Chemical-Specific Carcinogenic Risk	Dermal Chemical-Specific Noncarcinogenic Hazard Quotient	% Carcinogenic Risk	% Noncarcino-genic Risk
Arsenic	22.0	1.0E-06	5,800	1.0	0.01	250	25	70	9,125	25,550	4.5E-06	1.2E-05	1.8	0.0003	8.1E-06	4.0E-02	1.0E+02	1.0E+02
Lead	152	1.0E-06	5,800	1.0	0.01	250	25	70	9,125	25,550	3.1E-05	8.6E-05	-- [a]	--	--	--	--	--
														TOTAL PATHWAY RISK :	8.1E-06	HAZARD INDEX :	4.0E-02	

[a] Dashes (--) indicate that the slope factor (SF) and/or reference dose (RfD) were not available in the latest IRIS database (August 1994) or HEAST as of March 1994. Therefore, no risk were quantified.

INTAKE AND RISK CALCULATIONS FOR INCIDENTAL INGESTION
(AREA F; SOILS: 0 - 4 in. and 0.5 - 1.3 ft.)
INDUSTRIAL WORKER POPULATION
CURRENT SCENARIO

CDI (mg/kg-day) = (CS x CF x IR x FI x EF x ED) / (BW x AT)

RMI SODIUM PLANT
ASHTABULA, OHIO

Constituent	CS (mg/kg)	CF (kg/mg)	IR (mg/day)	FI (unitless)	EF (days/yr)	ED (yr)	BW (kg)	NC AT (days)	C AT (days)	C Chronic Daily Intake (mg/kg-day)	NC Chronic Daily Intake (mg/kg-day)	Oral Slope Factor (SF) 1/(mg/kg-day)	Oral Reference Dose (RfD) (mg/kg-day)	Oral Chemical-Specific Carcinogenic Risk	Oral Chemical-Specific Noncarcinogenic Hazard Quotient	% Carcinogenic Risk	% Noncarcino-genic Risk
Arsenic	22.0	1.0E-06	50	1.0	250	25	70	9,125	25,550	3.8E-06	1.1E-05	1.8	0.0003	6.8E-06	3.7E-02	1.0E+02	1.0E+02
Lead	152	1.0E-06	50	1.0	250	25	70	9,125	25,550	2.7E-05	7.4E-05	-- [a]	--	--	--	--	--
													TOTAL PATHWAY RISK :	6.8E-06	HAZARD INDEX :	3.7E-02		

[a] Dashes (--) indicate that the slope factor (SF) and/or reference dose (RfD) were not available in the latest IRIS database (August 1994) or HEAST as of March 1994. Therefore, no risk were quantified.

INTAKE AND RISK CALCULATIONS FOR INHALATION OF PARTICULATES
(AREA F; SOILS: 0 - 4 in. and 0.5 - 1.3 ft.)
INDUSTRIAL WORKER POPULATION
CURRENT SCENARIO

CDI (mg/kg-day) = (CA x IR x ET x EF x ED) / (BW x AT)

RMI SODIUM PLANT
ASHTABULA, OHIO

Constituent	CA (mg/m^3)	IR (m^3/hr)	ET (hr/day)	EF (days/yr)	ED (yr)	BW (kg)	NC AT (days)	C AT (days)	C Chronic Daily Intake (mg/kg-day)	NC Chronic Daily Intake (mg/kg-day)	Inhalation Slope Factor (SF) 1/(mg/kg-day)	Inhalation Reference Dose (RfD) (mg/kg-day)	Inhalation Chemical-Specific Carcinogenic Risk	Inhalation Chemical-Specific Noncarcinogenic Hazard Quotient	% Carcinogenic Risk	% Noncarcino-genic Risk
Arsenic	3.2E-09	0.83	8	250	25	70	9,125	25,550	7.4E-11	2.1E-10	50	-- [a]	3.7E-09	--	1.0E+02	--
Lead	2.2E-08	0.83	8	250	25	70	9,125	25,550	5.1E-10	1.4E-09	--	--	--	--	--	--
												TOTAL PATHWAY RISK :	3.7E-09	HAZARD INDEX :	--	

[a] Dashes (--) indicate that the slope factor (SF) and/or reference dose (RfD) were not available in the latest IRIS database (August 1994) or HEAST as of March 1994. Therefore, no risk were quantified.

INTAKE AND RISK CALCULATIONS FOR DERMAL CONTACT
(AREA G; SOILS: 0 - 4 in. and 0.5 - 3.3 ft.)
INDUSTRIAL WORKER POPULATION
CURRENT SCENARIO

CDI (mg/kg-day) = (CS x CF x SA x AF x ABS x EF x ED) / (BW x AT)

RMI SODIUM PLANT
ASHTABULA, OHIO

Constituent	CS (mg/kg)	CF (kg/mg)	SA (cm^2/day)	AF (mg/cm^2)	ABS (unitless)	EF (days/yr)	ED (yr)	BW (kg)	NC AT (days)	C AT (days)	C Chronic Daily Intake (Administered) (mg/kg-day)	NC Chronic Daily Intake (Administered) (mg/kg-day)	Oral Slope Factor (SF) 1/(mg/kg-day)	Oral Reference Dose (RfD) (mg/kg-day)	Dermal Chemical-Specific Carcinogenic Risk	Dermal Chemical-Specific Noncarcinogenic Hazard Quotient	% Carcinogenic Risk	% Noncarcino-genic Risk
Arsenic	23.5	1.0E-06	5,800	1.0	0.01	250	25	70	9,125	25,550	4.8E-06	1.3E-05	1.8	0.0003	8.6E-06	4.3E-02	1.0E+02	3.1E+01
Cadmium	173	1.0E-06	5,800	1.0	0.01	250	25	70	9,125	25,550	3.5E-05	9.8E-05	-- [a]	0.001	--	9.8E-02	--	7.0E+01
Lead	315	1.0E-06	5,800	1.0	0.01	250	25	70	9,125	25,550	6.4E-05	1.8E-04	--	--	--	--	--	--
															TOTAL PATHWAY RISK:	8.6E-06	HAZARD INDEX:	1.4E-01	

[a] Dashes (--) indicate that the slope factor (SF) and/or reference dose (RfD) were not available in the latest IRIS database (August 1994) or HEAST as of March 1994. Therefore, no risk were quantified.

INTAKE AND RISK CALCULATIONS FOR INCIDENTAL INGESTION
(AREA G; SOILS: 0 - 4 in. and 0.5 - 3.3 ft.)
INDUSTRIAL WORKER POPULATION
CURRENT SCENARIO

CDI (mg/kg-day) = (CS x CF x IR x FI x EF x ED) / (BW x AT)

RMI SODIUM PLANT
ASHTABULA, OHIO

Constituent	CS (mg/kg)	CF (kg/mg)	IR (mg/day)	FI (unitless)	EF (days/yr)	ED (yr)	BW (kg)	NC AT (days)	C AT (days)	C Chronic Daily Intake (mg/kg-day)	NC Chronic Daily Intake (mg/kg-day)	Oral Slope Factor (SF) 1/(mg/kg-day)	Oral Reference Dose (RfD) (mg/kg-day)	Oral Chemical-Specific Carcinogenic Risk	Oral Chemical-Specific Noncarcinogenic Hazard Quotient	% Carcinogenic Risk	% Noncarcino-genic Risk
Arsenic	23.5	1.0E-06	50	1.0	250	25	70	9,125	25,550	4.1E-06	1.1E-05	1.8	0.0003	7.4E-06	3.7E-02	1.0E+02	3.1E+01
Cadmium	173	1.0E-06	50	1.0	250	25	70	9,125	25,550	3.0E-05	8.5E-05	-- [a]	0.001	--	8.5E-02	--	7.1E+01
Lead	315	1.0E-06	50	1.0	250	25	70	9,125	25,550	5.5E-05	1.5E-04	--	--	--	--	--	--
														TOTAL PATHWAY RISK :	7.4E-06	HAZARD INDEX :	1.2E-01

[a] Dashes (--) indicate that the slope factor (SF) and/or reference dose (RfD) were not available in the latest IRIS database (August 1994) or HEAST as of March 1994. Therefore, no risk were quantified.

INTAKE AND RISK CALCULATIONS FOR INHALATION OF PARTICULATES
(AREA G; SOILS: 0 - 4 in. and 0.5 - 3.3 ft.)
INDUSTRIAL WORKER POPULATION
CURRENT SCENARIO

CDI (mg/kg-day) = (CA x IR x ET x EF x ED) / (BW x AT)

RMI SODIUM PLANT
ASHTABULA, OHIO

Constituent	CA (mg/m^3)	IR (m^3/hr)	ET (hr/day)	EF (days/yr)	ED (yr)	BW (kg)	NC AT (days)	C AT (days)	C Chronic Daily Intake (mg/kg-day)	NC Chronic Daily Intake (mg/kg-day)	Inhalation Slope Factor (SF) 1/(mg/kg-day)	Inhalation Reference Dose (RfD) (mg/kg-day)	Inhalation Chemical-Specific Carcinogenic Risk	Inhalation Chemical-Specific Noncarcinogenic Hazard Quotient	% Carcinogenic Risk	% Noncarcino-genic Risk
Arsenic	3.8E-09	0.83	8	250	25	70	9,125	25,550	8.8E-11	2.5E-10	50	-- [a]	4.4E-09	--	5.2E+01	--
Cadmium	2.8E-08	0.83	8	250	25	70	9,125	25,550	6.5E-10	1.8E-09	6.3	--	4.1E-09	--	4.8E+01	--
Lead	5.1E-08	0.83	8	250	25	70	9,125	25,550	1.2E-09	3.3E-09	--	--	--	--	--	--
												TOTAL PATHWAY RISK:	8.5E-09	HAZARD INDEX:	--	

[a] Dashes (--) indicate that the slope factor (SF) and/or reference dose (RfD) were not available in the latest IRIS database (August 1994) or HEAST as of March 1994. Therefore, no risk were quantified.

INTAKE AND RISK CALCULATIONS FOR DERMAL CONTACT
(AREA B; SOILS: 0 - 4 in. and 0.8 - 1.5 ft.)
RESIDENTIAL ADULT POPULATION
FUTURE SCENARIO

CDI (mg/kg-day) = (CS x CF x SA x AF x ABS x EF x ED) / (BW x AT)

RMI SODIUM PLANT
ASHTABULA, OHIO

Constituent	CS (mg/kg)	CF (kg/mg)	SA (cm^2/day)	AF (mg/cm^2)	ABS (unitless)	EF (days/yr)	ED (yr)	BW (kg)	NC AT (days)	C AT (days)	C Chronic Daily Intake (Administered) (mg/kg-day)	NC Chronic Daily Intake (Administered) (mg/kg-day)	Oral Slope Factor (SF) 1/(mg/kg-day)	Oral Reference Dose (RfD) (mg/kg-day)	Dermal Chemical-Specific Carcinogenic Risk	Dermal Chemical-Specific Noncarcinogenic Hazard Quotient	% Carcinogenic Risk	% Noncarcino-genic Risk
Arsenic	23.6	1.0E-06	5,800	1.0	0.01	350	30	70	10,950	25,550	8.0E-06	1.9E-05	1.8	0.0003	1.4E-05	6.3E-02	1.0E+02	9.8E+00
Cadmium	731	1.0E-06	5,800	1.0	0.01	350	30	70	10,950	25,550	2.5E-04	5.8E-04	-- [a]	0.001	--	5.8E-01	--	9.1E+01
Lead	1,140	1.0E-06	5,800	1.0	0.01	350	30	70	10,950	25,550	3.9E-04	9.1E-04	--	--	--	--	--	--
															TOTAL PATHWAY RISK:	1.4E-05	HAZARD INDEX:	6.4E-01		

[a] Dashes (--) indicate that the slope factor (SF) and/or reference dose (RfD) were not available in the latest IRIS database (August 1994) or HEAST as of March 1994. Therefore, no risk were quantified.

INTAKE AND RISK CALCULATIONS FOR INCIDENTAL INGESTION
(AREA B; SOILS: 0 - 4 in. and 0.8 - 1.5 ft.)
RESIDENTIAL ADULT POPULATION
FUTURE SCENARIO

CDI (mg/kg-day) = (CS x CF x IR x FI x EF x ED) / (BW x AT)

RMI SODIUM PLANT
ASHTABULA, OHIO

Constituent	CS (mg/kg)	CF (kg/mg)	IR (mg/day)	FI (unitless)	EF (days/yr)	ED (yr)	BW (kg)	NC AT (days)	C AT (days)	C Chronic Daily Intake (mg/kg-day)	NC Chronic Daily Intake (mg/kg-day)	Oral Slope Factor (SF) 1/(mg/kg-day)	Oral Reference Dose (RfD) (mg/kg-day)	Oral Chemical-Specific Carcinogenic Risk	Oral Chemical-Specific Noncarcinogenic Hazard Quotient	% Carcinogenic Risk	% Noncarcino-genic Risk
Arsenic	23.6	1.0E-06	100	1.0	350	30	70	10,950	25,550	1.4E-05	3.2E-05	1.8	0.0003	2.5E-05	1.1E-01	1.0E+02	1.0E+01
Cadmium	731	1.0E-06	100	1.0	350	30	70	10,950	25,550	4.3E-04	1.0E-03	-- [a]	0.001	--	1.0E+00	--	9.1E+01
Lead	1,140	1.0E-06	100	1.0	350	30	70	10,950	25,550	6.7E-04	1.6E-03	--	--	--	--	--	--
														TOTAL PATHWAY RISK:	2.5E-05	HAZARD INDEX:	1.1E+00

[a] Dashes (--) indicate that the slope factor (SF) and/or reference dose (RfD) were not available in the latest IRIS database (August 1994) or HEAST as of March 1994. Therefore, no risk were quantified.

INTAKE AND RISK CALCULATIONS FOR INHALATION OF PARTICULATES
(AREA B; SOILS: 0 - 4 in. and 0.8 - 1.5 ft.)
RESIDENTIAL ADULT POPULATION
FUTURE SCENARIO

CDI (mg/kg-day) = (CA x IR x ET x EF x ED) / (BW x AT)

RMI SODIUM PLANT
ASHTABULA, OHIO

Constituent	CA (mg/m^3)	IR (m^3/hr)	ET (hr/day)	EF (days/yr)	ED (yr)	BW (kg)	NC AT (days)	C AT (days)	C Chronic Daily Intake (mg/kg-day)	NC Chronic Daily Intake (mg/kg-day)	Inhalation Slope Factor (SF) 1/(mg/kg-day)	Inhalation Reference Dose (RfD) (mg/kg-day)	Inhalation Chemical-Specific Carcinogenic Risk	Inhalation Chemical-Specific Noncarcinogenic Hazard Quotient	% Carcinogenic Risk	% Noncarcino-genic Risk
Arsenic	2.7E-09	0.83	24	350	30	70	10,950	25,550	3.2E-10	7.4E-10	50	-- [a]	1.6E-08	--	2.1E+01	--
Cadmium	8.2E-08	0.83	24	350	30	70	10,950	25,550	9.6E-09	2.2E-08	6.3	--	6.0E-08	--	7.9E+01	--
Lead	1.3E-07	0.83	24	350	30	70	10,950	25,550	1.5E-08	3.5E-08	--	--	--	--	--	--
												TOTAL PATHWAY RISK:	7.6E-08	HAZARD INDEX:	--	

[a] Dashes (--) indicate that the slope factor (SF) and/or reference dose (RfD) were not available in the latest IRIS database (August 1994) or HEAST as of March 1994. Therefore, no risk were quantified.

INTAKE AND RISK CALCULATIONS FOR DERMAL CONTACT
(AREA C; SOILS: 0 - 4 in. and 1.4 - 1.8 ft.)
RESIDENTIAL ADULT POPULATION
FUTURE SCENARIO

CDI (mg/kg-day) = (CS x CF x SA x AF x ABS x EF x ED) / (BW x AT)

RMI SODIUM PLANT
ASHTABULA, OHIO

Constituent	CS (mg/kg)	CF (kg/mg)	SA (cm^2/day)	AF (mg/cm^2)	ABS (unitless)	EF (days/yr)	ED (yr)	BW (kg)	NC AT (days)	C AT (days)	C Chronic Daily Intake (Administered) (mg/kg-day)	NC Chronic Daily Intake (Administered) (mg/kg-day)	Oral Slope Factor (SF) 1/(mg/kg-day)	Oral Reference Dose (RfD) (mg/kg-day)	Dermal Chemical-Specific Carcinogenic Risk	Dermal Chemical-Specific Noncarcinogenic Hazard Quotient	% Carcinogenic Risk	% Noncarcino-genic Risk
Arsenic	23.4	1.0E-06	5,800	1.0	0.01	350	30	70	10,950	25,550	8.0E-06	1.9E-05	1.8	0.0003	1.4E-05	6.3E-02	1.0E+02	1.0E+02
Lead	209	1.0E-06	5,800	1.0	0.01	350	30	70	10,950	25,550	7.1E-05	1.7E-04	-- [a]	--	--	--	--	--
														TOTAL PATHWAY RISK:	1.4E-05	HAZARD INDEX:	6.3E-02	

[a] Dashes (--) indicate that the slope factor (SF) and/or reference dose (RfD) were not available in the latest IRIS database (August 1994) or HEAST as of March 1994. Therefore, no risk were quantified.

INTAKE AND RISK CALCULATIONS FOR INCIDENTAL INGESTION
(AREA C; SOILS: 0 - 4 in. and 1.4 - 1.8 ft.)
RESIDENTIAL ADULT POPULATION
FUTURE SCENARIO

CDI (mg/kg-day) = (CS x CF x IR x FI x EF x ED) / (BW x AT)

RMI SODIUM PLANT
ASHTABULA, OHIO

Constituent	CS (mg/kg)	CF (kg/mg)	IR (mg/day)	FI (unitless)	EF (days/yr)	ED (yr)	BW (kg)	NC AT (days)	C AT (days)	C Chronic Daily Intake (mg/kg-day)	NC Chronic Daily Intake (mg/kg-day)	Oral Slope Factor (SF) 1/(mg/kg-day)	Oral Reference Dose (RfD) (mg/kg-day)	Oral Chemical-Specific Carcinogenic Risk	Oral Chemical-Specific Noncarcinogenic Hazard Quotient	% Carcinogenic Risk	% Noncarcino-genic Risk
Arsenic	23.4	1.0E-06	100	1.0	350	30	70	10,950	25,550	1.4E-05	3.2E-05	1.8	0.0003	2.5E-05	1.1E-01	1.0E+02	1.0E+02
Lead	209	1.0E-06	100	1.0	350	30	70	10,950	25,550	1.2E-04	2.9E-04	-- [a]	--	--	--	--	--
													TOTAL PATHWAY RISK:	2.5E-05	HAZARD INDEX:	1.1E-01		

[a] Dashes (--) indicate that the slope factor (SF) and/or reference dose (RfD) were not available in the latest IRIS database (August 1994) or HEAST as of March 1994. Therefore, no risk were quantified.

INTAKE AND RISK CALCULATIONS FOR INHALATION OF PARTICULATES
(AREA C; SOILS: 0 - 4 in. and 1.4 - 1.8 ft.)
RESIDENTIAL ADULT POPULATION
FUTURE SCENARIO

CDI (mg/kg-day) = (CA x IR x ET x EF x ED) / (BW x AT)

RMI SODIUM PLANT
ASHTABULA, OHIO

Constituent	CA (mg/m^3)	IR (m^3/hr)	ET (hr/day)	EF (days/yr)	ED (yr)	BW (kg)	NC AT (days)	C AT (days)	C Chronic Daily Intake (mg/kg-day)	NC Chronic Daily Intake (mg/kg-day)	Inhalation Slope Factor (SF) 1/(mg/kg-day)	Inhalation Reference Dose (RfD) (mg/kg-day)	Inhalation Chemical-Specific Carcinogenic Risk	Inhalation Chemical-Specific Noncarcinogenic Hazard Quotient	% Carcinogenic Risk	% Noncarcino-genic Risk
Arsenic	3.8E-09	0.83	24	350	30	70	10,950	25,550	4.4E-10	1.0E-09	50	-- [a]	2.2E-08	--	1.0E+02	--
Lead	3.4E-08	0.83	24	350	30	70	10,950	25,550	4.0E-09	9.3E-09	--	--	--	--	--	--
													TOTAL PATHWAY RISK:	2.2E-08	HAZARD INDEX:	--

[a] Dashes (--) indicate that the slope factor (SF) and/or reference dose (RfD) were not available in the latest IRIS database (August 1994) or HEAST as of March 1994. Therefore, no risk were quantified.

INTAKE AND RISK CALCULATIONS FOR DERMAL CONTACT
(AREAS B & C; SOILS: 0 - 4 in. and 0.8 - 1.8 ft.)
RESIDENTIAL ADULT POPULATION
FUTURE SCENARIO

CDI (mg/kg-day) = (CS x CF x SA x AF x ABS x EF x ED) / (BW x AT)

RMI SODIUM PLANT
ASHTABULA, OHIO

Constituent	CS (mg/kg)	CF (kg/mg)	SA (cm^2/day)	AF (mg/cm^2)	ABS (unitless)	EF (days/yr)	ED (yr)	BW (kg)	NC AT (days)	C AT (days)	C Chronic Daily Intake (Administered) (mg/kg-day)	NC Chronic Daily Intake (Administered) (mg/kg-day)	Oral Slope Factor (SF) 1/(mg/kg-day)	Oral Reference Dose (RfD) (mg/kg-day)	Dermal Chemical-Specific Carcinogenic Risk	Dermal Chemical-Specific Noncarcinogenic Hazard Quotient	% Carcinogenic Risk	% Noncarcino-genic Risk
Arsenic	23.2	1.0E-06	5,800	1.0	0.01	350	30	70	10,950	25,550	7.9E-06	1.8E-05	1.8	0.0003	1.4E-05	6.0E-02	1.0E+02	9.4E+00
Cadmium	731	1.0E-06	5,800	1.0	0.01	350	30	70	10,950	25,550	2.5E-04	5.8E-04	-- [a]	0.001	--	5.8E-01	--	9.1E+01
Lead	1,140	1.0E-06	5,800	1.0	0.01	350	30	70	10,950	25,550	3.9E-04	9.1E-04	--	--	--	--	--	--
															TOTAL PATHWAY RISK:	1.4E-05	HAZARD INDEX:	6.4E-01		

[a] Dashes (--) indicate that the slope factor (SF) and/or reference dose (RfD) were not available in the latest IRIS database (August 1994) or HEAST as of March 1994. Therefore, no risk were quantified.

INTAKE AND RISK CALCULATIONS FOR INCIDENTAL INGESTION
(AREAS B & C; SOILS: 0 - 4 in. and 0.8 - 1.8 ft.)
RESIDENTIAL ADULT POPULATION
FUTURE SCENARIO

CDI (mg/kg-day) = (CS x CF x IR x FI x EF x ED) / (BW x AT)

RMI SODIUM PLANT
ASHTABULA, OHIO

Constituent	CS (mg/kg)	CF (kg/mg)	IR (mg/day)	FI (unitless)	EF (days/yr)	ED (yr)	BW (kg)	NC AT (days)	C AT (days)	C Chronic Daily Intake (mg/kg-day)	NC Chronic Daily Intake (mg/kg-day)	Oral Slope Factor (SF) 1/(mg/kg-day)	Oral Reference Dose (RfD) (mg/kg-day)	Oral Chemical-Specific Carcinogenic Risk	Oral Chemical-Specific Noncarcinogenic Hazard Quotient	% Carcinogenic Risk	% Noncarcino-genic Risk
Arsenic	23.2	1.0E-06	100	1.0	350	30	70	10,950	25,550	1.4E-05	3.2E-05	1.8	0.0003	2.5E-05	1.1E-01	1.0E+02	1.0E+01
Cadmium	731	1.0E-06	100	1.0	350	30	70	10,950	25,550	4.3E-04	1.0E-03	--[a]	0.001	--	1.0E+00	--	9.1E+01
Lead	1,140	1.0E-06	100	1.0	350	30	70	10,950	25,550	6.7E-04	1.6E-03	--	--	--	--	--	--
														TOTAL PATHWAY RISK:	2.5E-05	HAZARD INDEX:	1.1E+00

[a] Dashes (--) indicate that the slope factor (SF) and/or reference dose (RfD) were not available in the latest IRIS database (August 1994) or HEAST as of March 1994. Therefore, no risk were quantified.

INTAKE AND RISK CALCULATIONS FOR INHALATION OF PARTICULATES
(AREAS B & C; SOILS: 0 - 4 in. and 0.8 - 1.8 ft.)
RESIDENTIAL ADULT POPULATION
FUTURE SCENARIO

CDI (mg/kg-day) = (CA x IR x ET x EF x ED) / (BW x AT)

RMI SODIUM PLANT
ASHTABULA, OHIO

Constituent	CA (mg/m^3)	IR (m^3/hr)	ET (hr/day)	EF (days/yr)	ED (yr)	BW (kg)	NC AT (days)	C AT (days)	C Chronic Daily Intake (mg/kg-day)	NC Chronic Daily Intake (mg/kg-day)	Inhalation Slope Factor (SF) 1/(mg/kg-day)	Inhalation Reference Dose (RfD) (mg/kg-day)	Inhalation Chemical-Specific Carcinogenic Risk	Inhalation Chemical-Specific Noncarcinogenic Hazard Quotient	% Carcinogenic Risk	% Noncarcino-genic Risk
Arsenic	4.6E-09	0.83	24	350	30	70	10,950	25,550	5.4E-10	1.3E-09	50	-- [a]	2.7E-08	--	2.1E+01	--
Cadmium	1.4E-07	0.83	24	350	30	70	10,950	25,550	1.6E-08	3.8E-08	6.3	--	1.0E-07	--	7.7E+01	--
Lead	2.3E-07	0.83	24	350	30	70	10,950	25,550	2.7E-08	6.3E-08	--	--	--	--	--	--
												TOTAL PATHWAY RISK:	1.3E-07	HAZARD INDEX:	--	

[a] Dashes (--) indicate that the slope factor (SF) and/or reference dose (RfD) were not available in the latest IRIS database (August 1994) or HEAST as of March 1994. Therefore, no risk were quantified.

INTAKE AND RISK CALCULATIONS FOR INCIDENTAL INGESTION
(AREA F; SOILS: 0 - 4 in. and 0.5 - 1.3 ft.)
RESIDENTIAL ADULT POPULATION
FUTURE SCENARIO

CDI (mg/kg-day) = (CS x CF x IR x FI x EF x ED) / (BW x AT)

RMI SODIUM PLANT
ASHTABULA, OHIO

Constituent	CS (mg/kg)	CF (kg/mg)	IR (mg/day)	FI (unitless)	EF (days/yr)	ED (yr)	BW (kg)	NC AT (days)	C AT (days)	C Chronic Daily Intake (mg/kg-day)	NC Chronic Daily Intake (mg/kg-day)	Oral Slope Factor (SF) 1/(mg/kg-day)	Oral Reference Dose (RfD) (mg/kg-day)	Oral Chemical-Specific Carcinogenic Risk	Oral Chemical-Specific Noncarcinogenic Hazard Quotient	% Carcinogenic Risk	% Noncarcino-genic Risk
Arsenic	22.0	1.0E-06	100	1.0	350	30	70	10,950	25,550	1.3E-05	3.0E-05	1.8	0.0003	2.3E-05	1.0E-01	1.0E+02	1.0E+02
Lead	152	1.0E-06	100	1.0	350	30	70	10,950	25,550	8.9E-05	2.1E-04	-- [a]	--	--	--	--	--
													TOTAL PATHWAY RISK:	2.3E-05	HAZARD INDEX:	1.0E-01	

[a] Dashes (--) indicate that the slope factor (SF) and/or reference dose (RfD) were not available in the latest IRIS database (August 1994) or HEAST as of March 1994. Therefore, no risk were quantified.

INTAKE AND RISK CALCULATIONS FOR INHALATION OF PARTICULATES
(AREA F; SOILS: 0 - 4 in. and 0.5 - 1.3 ft.)
RESIDENTIAL ADULT POPULATION
FUTURE SCENARIO

CDI (mg/kg-day) = (CA x IR x ET x EF x ED) / (BW x AT)

RMI SODIUM PLANT
ASHTABULA, OHIO

Constituent	CA (mg/m^3)	IR (m^3/hr)	ET (hr/day)	EF (days/yr)	ED (yr)	BW (kg)	NC AT (days)	C AT (days)	C Chronic Daily Intake (mg/kg-day)	NC Chronic Daily Intake (mg/kg-day)	Inhalation Slope Factor (SF) 1/(mg/kg-day)	Inhalation Reference Dose (RfD) (mg/kg-day)	Inhalation Chemical-Specific Carcinogenic Risk	Inhalation Chemical-Specific Noncarcinogenic Hazard Quotient	% Carcinogenic Risk	% Noncarcino-genic Risk
Arsenic	3.2E-09	0.83	24	350	30	70	10,950	25,550	3.7E-10	8.7E-10	50	-- [a]	1.9E-08	--	1.0E+02	--
Lead	2.2E-08	0.83	24	350	30	70	10,950	25,550	2.6E-09	6.0E-09	--	--	--	--	--	--
												TOTAL PATHWAY RISK :	1.9E-08	HAZARD INDEX :	--	

[a] Dashes (--) indicate that the slope factor (SF) and/or reference dose (RfD) were not available in the latest IRIS database (August 1994) or HEAST as of March 1994. Therefore, no risk were quantified.

INTAKE AND RISK CALCULATIONS FOR DERMAL CONTACT
(AREA G; SOILS: 0 - 4 in. and 0.5 - 3.3 ft.)
RESIDENTIAL ADULT POPULATION
FUTURE SCENARIO

CDI (mg/kg-day) = (CS x CF x SA x AF x ABS x EF x ED) / (BW x AT)

RMI SODIUM PLANT
ASHTABULA, OHIO

Constituent	CS (mg/kg)	CF (kg/mg)	SA (cm^2/day)	AF (mg/cm^2)	ABS (unitless)	EF (days/yr)	ED (yr)	BW (kg)	NC AT (days)	C AT (days)	C Chronic Daily Intake (Administered) (mg/kg-day)	NC Chronic Daily Intake (Administered) (mg/kg-day)	Oral Slope Factor (SF) 1/(mg/kg-day)	Oral Reference Dose (RfD) (mg/kg-day)	Dermal Chemical-Specific Carcinogenic Risk	Dermal Chemical-Specific Noncarcinogenic Hazard Quotient	% Carcinogenic Risk	% Noncarcino-genic Risk
Arsenic	23.5	1.0E-06	5,800	1.0	0.01	350	30	70	10,950	25,550	8.0E-06	1.9E-05	1.8	0.0003	1.4E-05	6.3E-02	1.0E+02	3.2E+01
Cadmium	173	1.0E-06	5,800	1.0	0.01	350	30	70	10,950	25,550	5.9E-05	1.4E-04	-- [a]	0.001	--	1.4E-01	--	7.0E+01
Lead	315	1.0E-06	5,800	1.0	0.01	350	30	70	10,950	25,550	1.1E-04	2.5E-04	--	--	--	--	--	--
															TOTAL PATHWAY RISK:	1.4E-05	HAZARD INDEX:	2.0E-01

[a] Dashes (--) indicate that the slope factor (SF) and/or reference dose (RfD) were not available in the latest IRIS database (August 1994) or HEAST as of March 1994. Therefore, no risk were quantified.

INTAKE AND RISK CALCULATIONS FOR INCIDENTAL INGESTION
(AREA G; SOILS: 0 - 4 in. and 0.5 - 3.3 ft.)
RESIDENTIAL ADULT POPULATION
FUTURE SCENARIO

CDI (mg/kg-day) = (CS x CF x IR x FI x EF x ED) / (BW x AT)

RMI SODIUM PLANT
ASHTABULA, OHIO

Constituent	CS (mg/kg)	CF (kg/mg)	IR (mg/day)	FI (unitless)	EF (days/yr)	ED (yr)	BW (kg)	NC AT (days)	C AT (days)	C Chronic Daily Intake (mg/kg-day)	NC Chronic Daily Intake (mg/kg-day)	Oral Slope Factor (SF) 1/(mg/kg-day)	Oral Reference Dose (RfD) (mg/kg-day)	Oral Chemical-Specific Carcinogenic Risk	Oral Chemical-Specific Noncarcinogenic Hazard Quotient	% Carcinogenic Risk	% Noncarcino-genic Risk
Arsenic	23.5	1.0E-06	100	1.0	350	30	70	10,950	25,550	1.4E-05	3.2E-05	1.8	0.0003	2.5E-05	1.1E-01	1.0E+02	3.1E+01
Cadmium	173	1.0E-06	100	1.0	350	30	70	10,950	25,550	1.0E-04	2.4E-04	-- [a]	0.001	--	2.4E-01	--	6.9E+01
Lead	315	1.0E-06	100	1.0	350	30	70	10,950	25,550	1.8E-04	4.3E-04	--	--	--	--	--	--
														TOTAL PATHWAY RISK:	2.5E-05	HAZARD INDEX:	3.5E-01

[a] Dashes (--) indicate that the slope factor (SF) and/or reference dose (RfD) were not available in the latest IRIS database (August 1994) or HEAST as of March 1994. Therefore, no risk were quantified.

INTAKE AND RISK CALCULATIONS FOR INHALATION OF PARTICULATES
(AREA G; SOILS: 0 - 4 in. and 0.5 - 3.3 ft.)
RESIDENTIAL ADULT POPULATION
FUTURE SCENARIO

CDI (mg/kg-day) = (CA x IR x ET x EF x ED) / (BW x AT)

RMI SODIUM PLANT
ASHTABULA, OHIO

Constituent	CA (mg/m^3)	IR (m^3/hr)	ET (hr/day)	EF (days/yr)	ED (yr)	BW (kg)	NC AT (days)	C AT (days)	C Chronic Daily Intake (mg/kg-day)	NC Chronic Daily Intake (mg/kg-day)	Inhalation Slope Factor (SF) 1/(mg/kg-day)	Inhalation Reference Dose (RfD) (mg/kg-day)	Inhalation Chemical-Specific Carcinogenic Risk	Inhalation Chemical-Specific Noncarcinogenic Hazard Quotient	% Carcinogenic Risk	% Noncarcino-genic Risk
Arsenic	3.8E-09	0.83	24	350	30	70	10,950	25,550	4.4E-10	1.0E-09	50	-- [a]	2.2E-08	--	5.1E+01	--
Cadmium	2.8E-08	0.83	24	350	30	70	10,950	25,550	3.3E-09	7.6E-09	6.3	--	2.1E-08	--	4.9E+01	--
Lead	5.1E-08	0.83	24	350	30	70	10,950	25,550	6.0E-09	1.4E-08	--	--	--	--	--	--
												RISK:	4.3E-08	HAZARD INDEX:	--	

[a] Dashes (--) indicate that the slope factor (SF) and/or reference dose (RfD) were not available in the latest IRIS database (August 1994) or HEAST as of March 1994. Therefore, no risk were quantified.

INTAKE AND RISK CALCULATIONS FOR DERMAL CONTACT
(BACKGROUND; SOILS: 0 - 4 in. and 1 - 57 ft.)
INDUSTRIAL WORKER POPULATION
CURRENT SCENARIO

CDI (mg/kg-day) = (CS x CF x SA x AF x ABS x EF x ED) / (BW x AT)

RMI SODIUM PLANT
ASHTABULA, OHIO

Constituent	CS (mg/kg)	CF (kg/mg)	SA (cm^2/day)	AF (mg/cm^2)	ABS (unitless)	EF (days/yr)	ED (yr)	BW (kg)	NC AT (days)	C AT (days)	C Chronic Daily Intake (Administered) (mg/kg-day)	NC Chronic Daily Intake (Administered) (mg/kg-day)	Oral Slope Factor (SF) 1/(mg/kg-day)	Oral Reference Dose (RfD) (mg/kg-day)	Dermal Chemical-Specific Carcinogenic Risk	Dermal Chemical-Specific Noncarcinogenic Hazard Quotient	% Carcinogenic Risk	% Noncarcino-genic Risk
Arsenic	17.8	1.0E-06	5,800	1.0	0.01	250	25	70	9,125	25,550	3.6E-06	1.0E-05	1.8	0.0003	6.5E-06	3.3E-02	1.0E+02	9.4E+01
Cadmium	3.05	1.0E-06	5,800	1.0	0.01	250	25	70	9,125	25,550	6.2E-07	1.7E-06	-- [a]	0.001	--	1.7E-03	--	4.9E+00
Lead	27.3	1.0E-06	5,800	1.0	0.01	250	25	70	9,125	25,550	5.5E-06	1.5E-05	--	--	--	--	--	--
															TOTAL PATHWAY RISK:	6.5E-06	HAZARD INDEX:	3.5E-02	

[a] Dashes (--) indicate that the slope factor (SF) and/or reference dose (RfD) were not available in the latest IRIS database (August 1994) or HEAST as of March 1994. Therefore, no risk were quantified.

INTAKE AND RISK CALCULATIONS FOR INCIDENTAL INGESTION
(BACKGROUND; SOILS: 0 - 4 in. and 1 - 57 ft.)
INDUSTRIAL WORKER POPULATION
CURRENT SCENARIO

CDI (mg/kg-day) = (CS x CF x IR x FI x EF x ED) / (BW x AT)

RMI SODIUM PLANT
ASHTABULA, OHIO

Constituent	CS (mg/kg)	CF (kg/mg)	IR (mg/day)	FI (unitless)	EF (days/yr)	ED (yr)	BW (kg)	NC AT (days)	C AT (days)	C Chronic Daily Intake (mg/kg-day)	NC Chronic Daily Intake (mg/kg-day)	Oral Slope Factor (SF) 1/(mg/kg-day)	Oral Reference Dose (RfD) (mg/kg-day)	Oral Chemical-Specific Carcinogenic Risk	Oral Chemical-Specific Noncarcinogenic Hazard Quotient	% Carcinogenic Risk	% Noncarcino-genic Risk
Arsenic	17.8	1.0E-06	50	1.0	250	25	70	9,125	25,550	3.1E-06	8.7E-06	1.8	0.0003	5.6E-06	2.9E-02	1.0E+02	9.4E+01
Cadmium	3.05	1.0E-06	50	1.0	250	25	70	9,125	25,550	5.3E-07	1.5E-06	-- [a]	0.001	--	1.5E-03	--	4.8E+00
Lead	27.3	1.0E-06	50	1.0	250	25	70	9,125	25,550	4.8E-06	1.3E-05	--	--	--	--	--	--
														TOTAL PATHWAY RISK:	5.6E-06	HAZARD INDEX:	3.1E-02

[a] Dashes (--) indicate that the slope factor (SF) and/or reference dose (RfD) were not available in the latest IRIS database (August 1994) or HEAST as of March 1994. Therefore, no risk were quantified.

INTAKE AND RISK CALCULATIONS FOR INHALATION OF PARTICULATES
(BACKGROUND; SOILS: 0 - 4 in. and 1 - 57 ft.)
INDUSTRIAL WORKER POPULATION
CURRENT SCENARIO

CDI (mg/kg-day) = (CA x IR x ET x EF x ED) / (BW x AT)

RMI SODIUM PLANT
ASHTABULA, OHIO

Constituent	CA (mg/m^3)	IR (m^3/hr)	ET (hr/day)	EF (days/yr)	ED (yr)	BW (kg)	NC AT (days)	C AT (days)	C Chronic Daily Intake (mg/kg-day)	NC Chronic Daily Intake (mg/kg-day)	Inhalation Slope Factor (SF) 1/(mg/kg-day)	Inhalation Reference Dose (RfD) (mg/kg-day)	Inhalation Chemical-Specific Carcinogenic Risk	Inhalation Chemical-Specific Noncarcinogenic Hazard Quotient	% Carcinogenic Risk	% Noncarcino-genic Risk
Arsenic	3.5E-09	0.83	8	250	25	70	9,125	25,550	8.1E-11	2.3E-10	50	-- [a]	4.1E-09	--	9.8E+01	--
Cadmium	6.0E-10	0.83	8	250	25	70	9,125	25,550	1.4E-11	3.9E-11	6.3	--	8.8E-11	--	2.1E+00	--
Lead	5.4E-09	0.83	8	250	25	70	9,125	25,550	1.3E-10	3.5E-10	--	--	--	--	--	--
												TOTAL PATHWAY RISK:	4.2E-09	HAZARD INDEX:	--	

[a] Dashes (--) indicate that the slope factor (SF) and/or reference dose (RfD) were not available in the latest IRIS database (August 1994) or HEAST as of March 1994. Therefore, no risk were quantified.

INTAKE AND RISK CALCULATIONS FOR DERMAL CONTACT
(BACKGROUND; SOILS: 0 - 4 in. and 1 - 57 ft.)
RESIDENTIAL ADULT POPULATION
FUTURE SCENARIO

CDI (mg/kg-day) = (CS x CF x SA x AF x ABS x EF x ED) / (BW x AT)

RMI SODIUM PLANT
ASHTABULA, OHIO

Constituent	CS (mg/kg)	CF (kg/mg)	SA (cm^2/day)	AF (mg/cm^2)	ABS (unitless)	EF (days/yr)	ED (yr)	BW (kg)	NC AT (days)	C AT (days)	C Chronic Daily Intake (Administered) (mg/kg-day)	NC Chronic Daily Intake (Administered) (mg/kg-day)	Oral Slope Factor (SF) 1/(mg/kg-day)	Oral Reference Dose (RfD) (mg/kg-day)	Dermal Chemical-Specific Carcinogenic Risk	Dermal Chemical-Specific Noncarcinogenic Hazard Quotient	% Carcinogenic Risk	% Noncarcino-genic Risk
Arsenic	17.8	1.0E-06	5,800	1.0	0.01	350	30	70	10,950	25,550	6.1E-06	1.4E-05	1.8	0.0003	1.1E-05	4.7E-02	1.0E+02	9.6E+01
Cadmium	3.05	1.0E-06	5,800	1.0	0.01	350	30	70	10,950	25,550	1.0E-06	2.4E-06	-- [a]	0.001	--	2.4E-03	--	4.9E+00
Lead	27.3	1.0E-06	5,800	1.0	0.01	350	30	70	10,950	25,550	9.3E-06	2.2E-05	--	--	--	--	--	--
															TOTAL PATHWAY RISK:	1.1E-05	HAZARD INDEX:	4.9E-02	

[a] Dashes (--) indicate that the slope factor (SF) and/or reference dose (RfD) were not available in the latest IRIS database (August 1994) or HEAST as of March 1994. Therefore, no risk were quantified.

INTAKE AND RISK CALCULATIONS FOR INCIDENTAL INGESTION
(BACKGROUND; SOILS: 0 - 4 in. and 1 - 57 ft.)
RESIDENTIAL ADULT POPULATION
FUTURE SCENARIO

CDI (mg/kg-day) = (CS x CF x IR x FI x EF x ED) / (BW x AT)

RMI SODIUM PLANT
ASHTABULA, OHIO

Constituent	CS (mg/kg)	CF (kg/mg)	IR (mg/day)	FI (unitless)	EF (days/yr)	ED (yr)	BW (kg)	NC AT (days)	C AT (days)	C Chronic Daily Intake (mg/kg-day)	NC Chronic Daily Intake (mg/kg-day)	Oral Slope Factor (SF) 1/(mg/kg-day)	Oral Reference Dose (RfD) (mg/kg-day)	Oral Chemical-Specific Carcinogenic Risk	Oral Chemical-Specific Noncarcinogenic Hazard Quotient	% Carcinogenic Risk	% Noncarcino-genic Risk
Arsenic	17.8	1.0E-06	100	1.0	350	30	70	10,950	25,550	1.0E-05	2.4E-05	1.8	0.0003	1.8E-05	8.0E-02	1.0E+02	9.5E+01
Cadmium	3.05	1.0E-06	100	1.0	350	30	70	10,950	25,550	1.8E-06	4.2E-06	-- [a]	0.001	--	4.2E-03	--	5.0E+00
Lead	27.3	1.0E-06	100	1.0	350	30	70	10,950	25,550	1.6E-05	3.7E-05	--	--	--	--	--	--
														TOTAL PATHWAY RISK:	1.8E-05	HAZARD INDEX:	8.4E-02

[a] Dashes (--) indicate that the slope factor (SF) and/or reference dose (RfD) were not available in the latest IRIS database (August 1994) or HEAST as of March 1994. Therefore, no risk were quantified.

INTAKE AND RISK CALCULATIONS FOR INHALATION OF PARTICULATES
(BACKGROUND; SOILS: 0 - 4 in. and 1 - 57 ft.)
RESIDENTIAL ADULT POPULATION
FUTURE SCENARIO

CDI (mg/kg-day) = (CA x IR x ET x EF x ED) / (BW x AT)

RMI SODIUM PLANT
ASHTABULA, OHIO

Constituent	CA (mg/m^3)	IR (m^3/hr)	ET (hr/day)	EF (days/yr)	ED (yr)	BW (kg)	NC AT (days)	C AT (days)	C Chronic Daily Intake (mg/kg-day)	NC Chronic Daily Intake (mg/kg-day)	Inhalation Slope Factor (SF) 1/(mg/kg-day)	Inhalation Reference Dose (RfD) (mg/kg-day)	Inhalation Chemical-Specific Carcinogenic Risk	Inhalation Chemical-Specific Noncarcinogenic Hazard Quotient	% Carcinogenic Risk	% Noncarcino-genic Risk
Arsenic	3.5E-09	0.83	24	350	30	70	10,950	25,550	4.1E-10	9.6E-10	50	-- [a]	2.1E-08	--	1.0E+02	--
Cadmium	6.0E-10	0.83	24	350	30	70	10,950	25,550	7.0E-11	1.6E-10	6.3	--	4.4E-10	--	2.1E+00	--
Lead	5.4E-09	0.83	24	350	30	70	10,950	25,550	6.3E-10	1.5E-09	--	--	--	--	--	--
												TOTAL PATHWAY RISK :	2.1E-08	HAZARD INDEX :	--	

[a] Dashes (--) indicate that the slope factor (SF) and/or reference dose (RfD) were not available in the latest IRIS database (August 1994) or HEAST as of March 1994. Therefore, no risk were quantified.

APPENDIX B

CALCULATIONS OF THEORETICAL MAXIMUM CONCENTRATIONS IN SURFACE WATER ON THE BASIS OF SOLUBILITY

Constituent	Valence	Form	Solubility Product (Note 5)	Metal ion conc^{n} in equilibrium with this form	Controlling anion concentration	Remarks
Cd	+2	$CdCO_3$	2.5×10^{-14}	0.197 mg/l	$[CO_3^{=}] = 1.43 \times 10^{-8}$	See Note 1
				41.7 mg/l	$[CO_3^{=}] = 7.48 \times 10^{-10}$	"
				1.79×10^{-3} mg/l	$[CO_3^{=}] = 1.58 \times 10^{-6}$	"
				0.0120 mg/l	$[CO_3^{=}] = 2.34 \times 10^{-7}$	See Note 2
Cd	+2	$CdSO_4$	soluble			
Cd	+2	$Cd(OH)_2$	1.2×10^{-14}	$2.04 \times 10^{+5}$ mg/l	$[OH^-] = 8.13 \times 10^{-8}$	See Note 3, Soluble
				34.7 molar, soluble	$[OH^-] = 1.86 \times 10^{-8}$	" "
				1860 mg/l	$[OH^-] = 8.51 \times 10^{-7}$	"
Pb	+2	$PbCO_3$	1.5×10^{-13}	2.18 mg/l	$[CO_3^{=}] = 1.43 \times 10^{-8}$	See Note 1
				41.7 mg/l	$[CO_3^{=}] = 7.48 \times 10^{-10}$	"
				1.98×10^{-2} mg/l	$[CO_3^{=}] = 1.58 \times 10^{-6}$	"
				0.133 mg/l	$[CO_3^{=}] = 2.34 \times 10^{-7}$	See Note 2
Pb	+2	$PbSO_4$	1.8×10^{-8}	2.61 mg/l	$[SO_4^{=}] = 1.43 \times 10^{-3}$	See Note 4
Pb	+2	$Pb(OH)_2$	2.8×10^{-16}	8790 mg/l	$[OH^-] = 8.13 \times 10^{-8}$	See Note 3
				soluble (.809 molar)	$[OH^-] = 1.86 \times 10^{-8}$	"
				80.1 mg/l	$[OH^-] = 8.51 \times 10^{-7}$	"

Constituent	Valence	Form	Solubility Product	Metal ion conc. in equilibrium with this form	Controlling anion concentration	Remarks
Ba	+2	$BaCO_3$	8.1×10^{-9}	0.566 Molar (soluble)	$[CO_3^=] = 1.43 \times 10^{-8}$	See Note 1
				Soluble	$[CO_3^=] = 7.48 \times 10^{-10}$	" Soluble
				706 mg/l	$[CO_3^=] = 1.58 \times 10^{-6}$	"
Ba	+2	$BaSO_4$	1.1×10^{-10}	1.06×10^{-2} mg/l	$[SO_4^=] = 1.43 \times 10^{-3}$	See Note 4
Ba	+2	$Ba(OH)_2$	5.0×10^{-3}	Soluble	$[OH^-] = 8.13 \times 10^{-8}$	See Note 3 Soluble
				Soluble	$[OH^-] = 1.96 \times 10^{-8}$	See Note 3 Soluble
				Soluble	$[OH^-] = 8.51 \times 10^{-7}$	See Note 3 Soluble
Cu	+2	$CuCO_3$	2.5×10^{-10}	1110 mg/l	$[CO_3^=] = 1.43 \times 10^{-8}$	See Note 1
				10.0 mg/l	$[CO_3^=] = 1.58 \times 10^{-6}$	"
		$Cu(OH)_2$	1.6×10^{-19}	29.4 mg/l	$[OH^-] = 1.86 \times 10^{-8}$	See Note 3
				1.40×10^{-7} mg/l	$[OH^-] = 8.51 \times 10^{-7}$	"
		$CuSO_4$	Soluble			
Cr	+3	$Cr(OH)_3$	6.7×10^{-31}	5.41×10^{-3} mg/l	$[OH^-] = 1.86 \times 10^{-8}$	See Note 3
				5.65×10^{-8} mg/l	$[OH^-] = 8.51 \times 10^{-7}$	See Note 3
		$Cr_2(CO_3)_3$	unstable			
		$Cr_2(SO_4)_3$	soluble			

Constituent	Valence	Form	Solubility product	Metal ion conc in equilibrium with this form	Controlling anion concentration	Remarks
Ag	+1	Ag_2CO_3	8.1×10^{-12}	2.57×10^{-3} mg/l	$[CO_3^{=}] = 1.43 \times 10^{-8}$	Note 1
				2.44×10^{2} mg/l	$[CO_3^{=}] = 1.58 \times 10^{-6}$	"
		$AgOH$ (Ag_2O)	2.0×10^{-8}	1.16×10^{5} mg/l	$[OH^-] = 1.86 \times 10^{-8}$	Note 4
				2.54×10^{3} mg/l	$[OH^-] = 8.51 \times 10^{-7}$	"
		Ag_2SO_4	Fairly Soluble			

Note 1. Calculation of $[CO_3^=]$ with atmospheric CO_2 as the controlling factor.

$[H_2CO_3] = 0.033 \cdot P_{CO_2}$ (Whitten and Gailey, General Chemistry, Saunders, 1981, p. 280)

P_{CO_2}(atmospheric) $= 3.25 \times 10^{-4}$ atm (W and G, p. 683)

So $[H_2CO_3] = .033 \times 3.25 \times 10^{-4} = 1.07 \times 10^{-5}$ M(olar)

The pH of the water samples ranges from 6.27 to 7.93, with an average value of 6.91.

$[H^+] = 10^{-pH}$

$[H^+]_{ave} = 10^{-6.91} = 1.23 \times 10^{-7}$

Similarly $[H^+]_{max} = 5.37 \times 10^{-7}$

$[H^+]_{min} = 1.17 \times 10^{-8}$

Now for H_2CO_3, $K_1K_2 = \dfrac{[H^+]^2[CO_3^=]}{[H_2CO_3]}$,

so $[CO_3^=] = \dfrac{K_1K_2[H_2CO_3]}{[H^+]^2} = \dfrac{4.2 \times 10^{-7} \times 4.8 \times 10^{-11} \times 1.07 \times 10^{-5}}{[H^+]^2}$

(K_1 and K_2 from W and G). Then

$[CO_3^=]_{ave} = 1.43 \times 10^{-8}$ molar

$[CO_3^=]_{low\ pH} = 7.48 \times 10^{-10}$ "

$[CO_3^=]_{high\ pH} = 1.58 \times 10^{-6}$ "

Note 2, Calculation of $[CO_3^=]$ from the total bicarbonate data on the water samples.

The average value of HCO_3^- as $CaCO_3$ for the ten water samples is $77.46 \frac{mg}{l}$, This gives a total molar CO_3 concentration of $\frac{77.46 \times 10^{-3} gm/l}{100 gm/mole} = 7.75 \times 10^{-4}$ molar,

To determine how much of this is present as $CO_3^=$ we proceed as follows, The average $[H^+]$ is 1.23×10^{-7} molar,

$$K_1 = \frac{[H^+][HCO_3^-]}{[H_2CO_3]} = 4.2 \times 10^{-7}$$

$$K_2 = \frac{[H^+][CO_3^=]}{[HCO_3^-]} = 4.8 \times 10^{-11}$$

$$[CO_3] = 7.75 \times 10^{-4} = [H_2CO_3] + [HCO_3^-] + [CO_3^=]$$

from mass balance.

$$[H_2CO_3] = \frac{[H^+][HCO_3^-]}{K_1}$$

$$[CO_3^=] = \frac{K_2[HCO_3^-]}{[H^+]}$$

$$\text{So } 7.75 \times 10^{-4} = [HCO_3^-] \cdot \left(\frac{[H^+]}{K_1} + 1 + \frac{K_2}{[H^+]} \right)$$

Substituting in the values for $[H^+]$ K_1, and K_2 then yields $[HCO_3^-] = 5.99 \times 10^{-4} M$, from which we get $[CO_3^=] = \frac{K_2[HCO_3^-]}{[H^+]} = 2.23 \times 10^{-3} M$

Note 3. Calculation of $[OH^-]$ from pH.

$$[H^+] = 10^{-pH}$$

$$[H^+][OH^-] = 10^{-14}$$

$$[OH^-] = \frac{10^{-14}}{10^{-pH}} = 10^{pH-14}$$

The minimum $[OH^-]$ is obtained with the smallest pH; this is

$$[OH^-]_{min} = 10^{6,272-14} = 1,86 \times 10^{-8}$$

Similarly, $[OH]_{max} = 10^{11,93-14} = 8,51 \times 10^{-3}$

Note 4. Calculation of $[SO_4^{=}]$.

The average sulfate concentration for the ten water samples is $137 \frac{mg}{\ell}$. This gives

$$[SO_4^{=}] = \frac{137 \times 10^{-3} \frac{gm}{mg}}{96 gm/mole} = 1.43 \times 10^{-3} M.$$

Note 5. All solubility products and other equilibrium constants, etc., were taken from Whitten and Gailey, General Chemistry, published by Saunders in 1981.

APPENDIX C

INTEGRATED RISK INFORMATION SYSTEM (IRIS) PRINTOUTS

Arsenic, inorganic; CASRN 7440-38-2 (02/01/91)

Health risk assessment information on a chemical is included in IRIS only after a comprehensive review of chronic toxicity data by work groups composed of U.S. EPA scientists from several Program Offices. The summaries presented in Sections I and II represent a consensus reached in the review process. The other sections contain U.S. EPA information which is specific to a particular EPA program and has been subject to review procedures prescribed by that Program Office. The regulatory actions in Section IV may not be based on the most current risk assessment, or may be based on a current, but unreviewed, risk assessment, and may take into account factors other than health effects (e.g., treatment technology). When considering the use of regulatory action data for a particular situation, note the date of the regulatory action, the date of the most recent risk assessment relating to that action, and whether technological factors were considered. Background information and explanations of the methods used to derive the values given in IRIS are provided in the five Background Documents in Service Code 5, which correspond to Sections I through V of the chemical files.

STATUS OF DATA FOR Arsenic, inorganic

File On-Line 02/10/88

Category (section)	Status	Last Revised
Oral RfD Assessment (I.A.)	pending	
Inhalation RfC Assessment (I.B.)	no data	
Carcinogenicity Assessment (II.)	on-line	02/01/91
Drinking Water Health Advisories (III.A.)	no data	
U.S. EPA Regulatory Actions (IV.)	on-line	06/01/90
Supplementary Data (V.)	no data	

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I. CHRONIC HEALTH HAZARD ASSESSMENTS FOR NONCARCINOGENIC EFFECTS

I.A. REFERENCE DOSE FOR CHRONIC ORAL EXPOSURE (RfD)

Substance Name -- Arsenic, inorganic
CASRN -- 7440-38-2

A risk assessment for this substance/agent will be reviewed by an EPA work group.

__I.B. REFERENCE CONCENTRATION FOR CHRONIC INHALATION EXPOSURE (RfC)

Substance Name -- Arsenic, inorganic
CASRN -- 7440-38-2

Not available at this time.

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_II. CARCINOGENICITY ASSESSMENT FOR LIFETIME EXPOSURE

Substance Name -- Arsenic, inorganic
CASRN -- 7440-38-2
Last Revised -- 02/01/91

Section II provides information on three aspects of the carcinogenic risk assessment for the agent in question; the U.S. EPA classification, and quantitative estimates of risk from oral exposure and from inhalation exposure. The classification reflects a weight-of-evidence judgment of the likelihood that the agent is a human carcinogen. The quantitative risk estimates are presented in three ways. The slope factor is the result of application of a low-dose extrapolation procedure and is presented as the risk per (mg/kg)/day. The unit risk is the quantitative estimate in terms of either risk per ug/L drinking water or risk per ug/cu.m air breathed. The third form in which risk is presented is a drinking water or air concentration providing cancer risks of 1 in 10,000, 1 in 100,000 or 1 in 1,000,000. Background Document 2 (Service Code 5) provides details on the rationale and methods used to derive the carcinogenicity values found in IRIS. Users are referred to Section I for information on long-term toxic effects other than carcinogenicity.

<<< Arsenic, inorganic >>>

__II.A. EVIDENCE FOR CLASSIFICATION AS TO HUMAN CARCINOGENICITY

___II.A.1. WEIGHT-OF-EVIDENCE CLASSIFICATION

Classification -- A; human carcinogen

Basis -- based on observation of increased lung cancer mortality in populations exposed primarily through inhalation and on increased skin cancer incidence in several populations consuming drinking water with high arsenic concentrations.

<<< Arsenic, inorganic >>>

___II.A.2. HUMAN CARCINOGENICITY DATA

Studies of smelter worker populations (Tacoma, WA; Magma, UT; Anaconda, MT; Ronnskar, Sweden; Saganoseki-Machii, Japan) have all found an association between occupational arsenic exposure and lung cancer mortality

(Enterline and Marsh, 1982; Lee-Feldstein, 1983; Axelson et al., 1978; Tokudome and Kuratsune, 1976; Rencher et al., 1977). Both proportionate mortality and cohort studies of pesticide manufacturing workers have shown an excess of lung cancer deaths among exposed persons (Ott et al., 1974; Mabuchi et al., 1979). One study of a population residing near a pesticide manufacturing plant revealed that these residents were also at an excess risk of lung cancer (Matanoski et al., 1981). Case reports of arsenical pesticide applicators have also demonstrated an association between arsenic exposure and lung cancer (Roth, 1958).

A cross-sectional study of 40,000 Taiwanese exposed to arsenic in drinking water found significant excess skin cancer prevalence by comparison to 7500 residents of Taiwan and Matsu who consumed relatively arsenic-free water (Tseng et al., 1968). This study design limited its usefulness in risk estimation. Arsenic-induced skin cancer has also been attributed to water supplies in Chile, Argentina and Mexico (Borgono and Greiber, 1972; Bergoglio, 1964; Cebrian et al., 1983). No excess skin cancer incidence has been observed in U.S. residents consuming relatively high levels of arsenic in drinking water (Morton et al., 1976; Southwick et al., 1981). The results of these U.S. studies, however, are not necessarily inconsistent with the existing findings from the foreign populations. The statistical powers of the U.S. studies are considered to be inadequate because of the small sample size.

A follow-up study (Tseng, 1977) of the population living in the same area of Taiwan, where arsenic contamination of the water supply was endemic, found significantly elevated standard mortality ratios for cancer of the bladder, lung, liver, kidney, skin and colon. This study of bladder, liver and lung cancer cases in the endemic area found a significant association with arsenic exposure that was dose-related. The association of arsenic ingestion and cancer of various internal organs has also been cited in a number of case reports (Chen et al., 1985, 1986). Persons treated with arsenic-containing medicinals have also been shown to be at a risk of skin cancer (Sommers and McManus, 1953).

<<< Arsenic, inorganic >>>

___II.A.3. ANIMAL CARCINOGENICITY DATA

None. There has not been consistent demonstration of arsenic carcinogenicity in test animals for various chemical forms administered by different routes to several species (IARC, 1980). There are some data to indicate that arsenic may produce animal tumors if retention time in the lung can be increased (Pershagen et al., 1982, 1984).

<<< Arsenic, inorganic >>>

___II.A.4. SUPPORTING DATA FOR CARCINOGENICITY

Sodium arsenate has been shown to transform Syrian hamster embryo cells (Dipaolo and Casto, 1979) and to produce sister-chromatid-exchange in DON cells, CHO cells and human peripheral lymphocytes exposed in vitro (Wan et al., 1982; Ohno et al., 1982; Larramendy et al., 1981; Andersen, 1983; Crossen, 1983). While arsenic compounds have not been shown to mutate bacterial strains, it produces preferential killing of repair deficient strains (Rossman, 1981).

---------<<< Arsenic, inorganic >>>----------

__II.B. QUANTITATIVE ESTIMATE OF CARCINOGENIC RISK FROM ORAL EXPOSURE

The Risk Assessment Forum has completed a reassessment of the carcinogenicity risk associated with ingestion of inorganic arsenic. This report, which has been extensively peer-reviewed by outside reviewers (including SAB review) concluded that the most appropriate basis for an oral quantitative estimate was the study by Tseng et al. (1977), which reported increased prevalence of skin cancers in humans as a consequence of arsenic exposure in drinking water. Based on this study a unit risk of 5E-5/ug/L was proposed.

A recent memorandum by the Administrator of the EPA recommended that the above unit risk be adopted. The memorandum further counsels that "in reaching risk management decisions in a specific situation, risk managers must recognize and consider the qualities and uncertainties of risk estimates. The uncertainties associated with ingested inorganic arsenic are such that estimates could be modified downwards as much as an order of magnitude, relative to risk estimates associated with most other carcinogens. In such instances, the management document must clearly articulate this fact and state the factors that influenced such a decision."

----------<<< Arsenic, inorganic >>>----------

__II.C. QUANTITATIVE ESTIMATE OF CARCINOGENIC RISK FROM INHALATION EXPOSURE

___II.C.1. SUMMARY OF RISK ESTIMATES

Inhalation Unit Risk -- 4.3E-3/ug/cu.m

Extrapolation Method -- absolute-risk linear model

Air Concentrations at Specified Risk Levels:

Risk Level	Concentration
E-4 (1 in 10,000)	2E-2 ug/cu.m
E-5 (1 in 100,000)	2E-3 ug/cu.m
E-6 (1 in 1,000,000)	2E-4 ug/cu.m

<<< Arsenic, inorganic >>>

___II.C.2. DOSE-RESPONSE DATA FOR CARCINOGENICITY, INHALATION EXPOSURE

Tumor Type -- lung cancer
Test Animals -- human, male
Route -- inhalation, occupational exposure
Reference -- Brown and Chu, 1983a,b,c; Lee-Feldstein, 1983; Higgins, 1982; Enterline and Marsh, 1982

Ambient Unit Risk Estimates

Exposure Source	Study	Unit Risk	Geometric Mean Unit Risk	Final Estimates Unit Risk
Anaconda smelter	Brown and Chu, 1983a,b,c	1.25 E-3		
	Lee-Feldstein, 1983	2.80 E-3	2.56 E-3	

	Higgins, 1982; Higgins et al., 1982; Welch et al., 1982	4.90 E-3	4.29 E-3
ASARCO smelter	Enterline and Marsh, 1982	6.81 E-3 7.60 E-3	7.19 E-3

<<< Arsenic, inorganic >>>

___II.C.3. ADDITIONAL COMMENTS (CARCINOGENICITY, INHALATION EXPOSURE)

A geometric mean was obtained for data sets obtained within distinct exposed populations (U.S. EPA, 1984). The final estimate is the geometric mean of those two values. It was assumed that the increase in age-specific mortality rate of lung cancer was a function only of cumulative exposures.

The unit risk should not be used if the air concentration exceeds 2 ug/cu.m, since above this concentration the unit risk may not be appropriate.

<<< Arsenic, inorganic >>>

___II.C.4. DISCUSSION OF CONFIDENCE (CARCINOGENICITY, INHALATION EXPOSURE)

Overall a large study population was observed. Exposure assessments included air measurements for the Anaconda smelter and both air measurements and urinary arsenic for the ASARCO smelter. Observed lung cancer incidence was significantly increased over expected values. The range of the estimates derived from data from two different exposure areas was within a factor of 6.

----------<<< Arsenic, inorganic >>>----------

__II.D. EPA DOCUMENTATION, REVIEW, AND CONTACTS (CARCINOGENICITY ASSESSMENT)

___II.D.1. EPA DOCUMENTATION

U.S. EPA. 1984. Health Assessment Document for Inorganic Arsenic. Environmental Criteria and Assessment Office, Research Triangle Park, NC. EPA 600/8-83-021F.

<<< Arsenic, inorganic >>>

___II.D.2. REVIEW (CARCINOGENICITY ASSESSMENT)

The 1984 Health Assessment Document for Inorganic Arsenic received Agency and external review including a review by SAB.

Agency Work Group Review: 01/13/88

Verification Date: 01/13/88

___II.D.3. U.S. EPA CONTACTS (CARCINOGENICITY ASSESSMENT)

Herman J. Gibb / ORD -- (202)382-5898 / FTS 382-5898

Chao W. Chen / ORD -- (202)382-5898 / FTS 382-5898

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_III. HEALTH HAZARD ASSESSMENTS FOR VARIED EXPOSURE DURATIONS

__III.A. DRINKING WATER HEALTH ADVISORIES

Substance Name -- Arsenic, inorganic
CASRN -- 7440-38-2

Not available at this time.

__III.B. OTHER ASSESSMENTS

Substance Name -- Arsenic, inorganic
CASRN -- 7440-38-2

Content to be determined.

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_IV. U.S. EPA REGULATORY ACTIONS

Substance Name -- Arsenic, inorganic
CASRN -- 7440-38-2
Last Revised -- 06/01/90

EPA risk assessments may be updated as new data are published and as assessment methodologies evolve. Regulatory actions are frequently not updated at the same time. Compare the dates for the regulatory actions in this section with the verification dates for the risk assessments in sections I and II, as this may explain inconsistencies. Also note that some regulatory actions consider factors not related to health risk, such as technical or economic feasibility. Such considerations are indicated for each action. In addition, not all of the regulatory actions listed in this section involve enforceable federal standards. Please direct any questions you may have concerning these regulatory actions to the U.S. EPA contact listed for that particular action. Users are strongly urged to read the background information on each regulatory action in Background Document 4 in Service Code 5.

<<< Arsenic, inorganic >>>

__IV.A. CLEAN AIR ACT (CAA)

No data available